

What Is Claimed Is:

1. An electron emission element comprising a substrate, and a protrusion protruding from the substrate and including boron-doped diamond:

5                   the protrusion comprising a columnar body;

                  a tip portion of the protrusion comprising an acicular body sticking out therefrom; and

10                 the distance  $r$  [cm] between a center axis and a side face in the columnar body and the boron concentration  $Nb$  [ $\text{cm}^{-3}$ ] in the diamond satisfying the relationship represented by the following formula (1):

$$r > \frac{10^4}{\sqrt{Nb}} \quad (1).$$

2. The electron emission element according to claim 1,

15                 wherein the distance  $r$  [cm] between the center axis and side face in the columnar body is  $0.1 \mu\text{m}$  or less; and

                  wherein the boron concentration in the diamond is  $5 \times 10^{19} \text{ cm}^{-3}$  or more.

20                 3. An electron emission element comprising a substrate, and a protrusion protruding from the substrate and including boron-doped diamond:

                  the protrusion comprising a columnar body;

                  a tip portion of the protrusion comprising an acicular body sticking out therefrom;

25                 diamond crystal included in the tip portion of the protrusion being terminated with hydrogen; and

the distance  $r$  [cm] between a center axis and a side face in the columnar body and the boron concentration  $Nb$  [ $\text{cm}^{-3}$ ] in the diamond satisfying the relationship represented by the following formula (2):

$$5 \quad r > \frac{10^2}{\sqrt{Nb}} \quad (2).$$

4. The electron emission element according to claim 1,

wherein the diamond is doped with nitrogen; and

10 wherein the boron concentration  $Nb$  [ $\text{cm}^{-3}$ ] in the diamond is higher than the nitrogen concentration  $Nn$  [ $\text{cm}^{-3}$ ] therein.

5. The electron emission element according to claim 4,

wherein the diamond is doped with nitrogen; and

15 wherein the boron concentration  $Nb$  [ $\text{cm}^{-3}$ ] and nitrogen concentration  $Nn$  [ $\text{cm}^{-3}$ ] in the diamond satisfy the relationship represented by the following formula (3):

$$Nb - Nn < 6 \times 10^{18} \quad (3).$$

6. The electron emission element according to claim 1, wherein the protrusion protrudes from a (111) sector of a diamond formed by a high pressure-high temperature synthesis.

20 7. The electron emission element according to claim 3, wherein the protrusion protrudes from a (311) or (110) sector of a diamond formed by a high pressure-high temperature synthesis.

8. The electron emission element according to claim 1, wherein the substrate comprises a diamond formed by a vapor-phase synthesis.